In the United States Patent and Trademark Office

Serial No. _____

Appn. Filed : _____

Applicant: Yuri Glukhoy

Appn. Title: MASS SPECTROMETRY SYSTEM FOR CONTINUOUS CONTROL OF ENVIRONMENT

Examiner/GAU: _____

Mailed: April 14/04

At: San Carlos, CA

Information Disclosure Statement

Commissioner for Patents

P.O. Box 1450, Alexandria, VA 22313-1450

Sir:

An example of one of the aforementioned programs is development of this program is carried out by a number of companies and universities, such as

University of South Florida, Applied Microsystems Ltd., International Submarine Engineering in British Columbia, and some other companies carry out a study, in the frameworks of the Department of National Defense, aimed at development of an autonomous underwater vehicles (AUVs) for environmental monitoring in deep water. The system is mounted on a submarine torpedo or mini-submarine platform that can collect samples of water and provide on-board analysis of the collected samples. The main measurement instrument is a mass spectrometer

designed by the University of South Florida and sold to Applied Microsystems Ltd. in British Columbia. An advantage of the above-described underwater environment control system is that it utilizes a mass spectrometer, which is the most universal medium-control sensor.

However, the environment control system described above, as well any other system of this type known to the applicant of the present patent application, has a number of disadvantages. The main disadvantage is that the mass spectrometers used in these systems are unable to operate with a high-duty cycle as high as 98% and for a majority of known aerosol mass spectrometers the duty cycle does not exceed 40-50%. Simply speaking, the mass spectrometer does not analyze the medium on the half of its operation cycle.

"Industrial Plasma Engineering" by Reece Roth, Vol. 1, Institute of Physics Publishing, Bristol and Philadelphia, 1992, pp. 206-218, describes sources of charged particles suitable for use in mass spectrometers.

US Patent No. 5,396,065 issued in 1995 to C. Myerholtz, et al. discloses an encoded sequence of charged-particles in packets for use in time-of-flight mass spectrometers, in which the high-mass charged particles of a leading packet will be passed by the low-mass charged particles of a trailing packet. However, the method and apparatus of the aforementioned patent make interpretation of obtained data more complicated and not easily comprehensible. Furthermore, addition electronic circuits are required for control of the charged particle packet sequence. However, such method and apparatus make interpretation of obtained data more complicated and not easily comprehensible. Furthermore, addition electronic circuits are required for control of the charged particle packet sequence.

US Patent No. 5,753,909 issued in 1998 to M. Park et al. describes a method and apparatus for analyzing charged particles by determining times of flight including using a collision cell to activate charged particles toward fragmentation and a deflector to direct charged particles away from their otherwise intended or parallel course. A disadvantage of this device consists in that it is based on the selection of specific charged particles and does not show the entire mass spectrum. For obtaining the entire spectrum, it is necessary to perform step by step scanning, and this requires an additional time. A disadvantage of the device disclosed in US Patent No. 5,753,909 consists in that this mass spectrometer is based on the selection of specific charged particles and does not show the entire mass spectrum. For obtaining the entire spectrum, it is necessary to perform step by step scanning, and this requires an additional time. In other words, the apparatus is not suitable for operation in an envoronment monitoring system operating in a continuous mode.

US Patent No. 6107,625 issued in 2000 to M. Park discloses a coaxial multiple reflection time-of-flight mass spectrometer of a time-of-flight type with resolution capacity improved due to a longer time of flight of the charged particles. The apparatus comprises two or more electrostatic reflectors positioned coaxially with respect to one another such that charged particles generated by a charged-particle source can be reflected back and forth between them. This system with storage of charged particles does not allow a continuous mode of mass analysis. The data is difficult to interpret, especially when masses of charged particles are scattered in a wide range. Thus, the apparatus is not suitable for operation in an envoronment monitoring system operating in a continuous mode.

U.S. Patent Application No. 10/058,153 field by Yu. Glukhoy on January 29, 2003 discloses a quadrupole mass spectrometer that provides extended time of flight trajectory and hence a very high the time resolution. A mass spectrometer of the

aforementioned patent application is based on the use of quadrupole lenses with an angular gradient of the electrostatic field from lens to lens. The charged particles perform flights in direct and reverse directions along helical trajectories. However, the above-described helical-path quadrupole mass spectrometer, as well as all aforementioned known mass spectrometers of other types, is not very convenient for aerosol applications and is not suitable for operation in an envoronment monitoring system operating in a continuous mode.

Different methods used for reconstruction of the particle distribution spectra in acquisition period of the cycle of mass spectrometer are described in the following literature sources: 1) G. Wilhelmi, et al. in "Binary Sequences and Error Analysis for Pseudo-Statistical Neutron Modulators with Different Duty Cycles," Nuclear Inst. and Methods, 81 (1970), pp. 36-44; 2) Myerholtz, et al. " Sequencing ion packets for ion time-of-flight mass spectrometry" (see aforementioned US Patent 5,396,065 described earlier in the description of the prior art); 3) Cocg "High duty cycle pseudo-noise modulated time-of-flight mass spectrometry" (US Patent 6,198,096, issued March 6, 2001; 4) Brock, et al. "Time-of-flight mass spectrometer and ion analysis" (US Patent 6, 300,626, issued October 9, 2001); 5) Overney, et al. "Deconvolution method and apparatus for analyzing compounds" (US Patent 6,524,803, issued February 25, 2003), etc. The above methods utilize special properties of the pulsing sequence, e.g., a pseudo-random binary sequence (PRBS) or Hadamard Transform. However, they cannot reach a high duty-cycle because their TOF MS's annihilate a part of the flow of charged particles by a gating grid [see references 3) and 4)] or deflecting mesh [see reference 5)] during binary modulation that they converted. This is because at least a half of the charged-particle flow must be discarded to allow the other half to be counted. The flow of charged particles sputters and contaminates the modulation grids or meshes and creates secondary electron-, ion-, or photon-emission leading to deterioration of the grids. Furthermore, foreign species introduced in the drift space because of

contamination and sputtering destruct the detectors and distort the information. The low sensitive flat deflection system, which is used in the in the A. Brock et al TOF-MS for the Hadamard's transform, contains a high density array of the wires with alternating potential that leads to breakdown.

The disadvantages of all known aerosol TOF MS's make them unsuitable for aforementioned high-duty analysis under extreme or critical conditions such a biological attack or an environmental disaster, e.g., a hazardous leakage or contamination of water reservoirs in populated areas.

Thus, none of the aforementioned references discloses, as claimed in my main Claim 1 with dependent Claims 2-29, a mass spectrometry system for continuous control of environment based on the use of an aerosol TOF MS with a quadrupole lens system that provides operation with a high duty cycle of up to 98% and can be realized in the form of a mobile unit having a data acquisition and analysis system with three levels of data correlation on the basis of constant interaction between various actuating mechanisms of the system via a central processing unit.

Applicant:  03. 26. 04

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

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Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Yuri Glukhoy
Art Unit	
Examiner Name	
Attorney Docket Number	

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US- 5,396,065	1995	C. Myerholtz, et.al.	
		US-			
		US- 5,753,909	1998	M. Park et al	
		US-			
		US- 6,107,625	2000	M. Park	
		US-			
		US- Pat. Appl.	10/058153 filed Jan. 29, 03	Y. Glukhoy	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] Number[4] Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Yuri Glukhoy
Art Unit	
Examiner Name	
Attorney Docket Number	

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	1)	Edwin Danson, UK. The Economics of Scale: Using Autonomous Underwater Vehicles (AUVs) for Wide-Area Hydrographic Survey and Ocean Data Acquisition	
	2)	G. Wilhelmi et al. "Binary Sequences ....", Nuclear Instr. & Methods, 81, 1970, pp. 36-44	
	3)	Reece Roth, "Industrial Plasma Engineering", Vol. 1, Institute of physics Publishing, Bristol and Philadelphia, 1992, pp. 206-218	
	4)	Myerholtz, et al. "Sequencing ion packets for ion time-of-flight mass spectrometry (see US Pat-5,396,065)	
	5)	Coca "High duty cycle pseudo-noise modulated TOF MS" (US pat-6198,096).	
	6)	Brock, et al. "TOF MS and ion analysis (US Pat-6,300,626)	
	7)	Oveeney et al. "Deconvolution Method and Apparatus" US Pat. 6,524,803).	

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